
Mainer Associates

Planning - Whole Life Carbon Assessment

Jacquet, Tankersley

Jarvale Construction

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EXECUTIVE SUMMARY

Mainer Associates have conducted a Whole Life Embodied Carbon Assessment (WLCA) on the Stage 2 Jacquet, Tankersley Industrial Storage and Process Warehouse design submitted for planning. Following initial submission of the application to Barnsley Metropolitan Borough Council, the Planning Officer has requested the project team submit an Energy & Sustainability Statement, and a Whole Life Carbon Assessment.

Barnsley's Local Plan recently adopted a new Supplementary Planning Document (SPD), *Sustainability Planning Document and Climate Change Adaptation* in July 2023. The SPD states:

A whole life carbon assessment (WLCA) will be required with full or hybrid applications or assessment of approval of reserved matters for major developments, and where minded, added as conditions to outline planning applications. The WLCA will be expected to follow the model set out in the RICS professional statement 2017, or the latest subsequent version.

Mainer Associates have therefore undertaken the Stage 2 WLCA according to British Standard BS EN15978:2011 (Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method), using the RICS Professional Statement *'Whole life carbon assessment for the built environment 2017'* as the industry recognised methodology to align the work to this British standard. This assessment methodology is also appropriate for clients wanting to eventually make Net Zero Carbon (NZC) status claims.

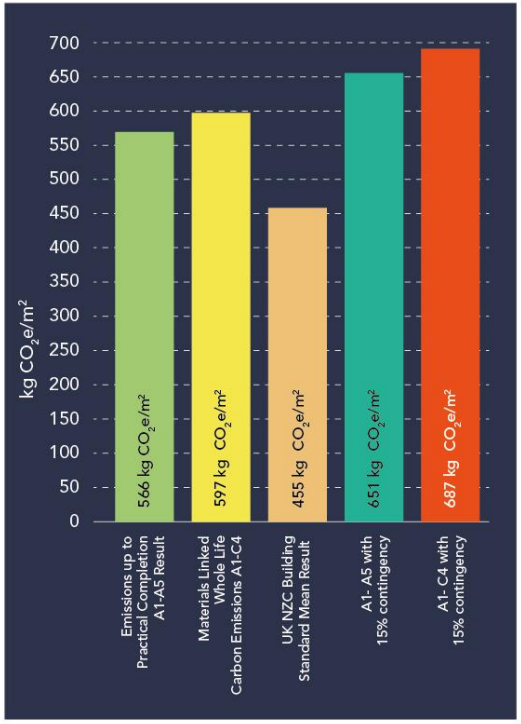
We have used the recently published RICS 2nd edition 2023 as the latest version. Due to Concept Design detail at this early stage Mainer have aligned the work as close as feasibly possible, but in certain instances have had to use estimates and allowances, all of which are detailed in the report for transparency.

We have used One Click LCA software to complete the LCA, utilising One Click Carbon Designer feature which allows to enter high-level information on the buildings geometry to generate carbon figures in the early stages. However, we deemed the limited range of the Carbon Designers material data too limited, even at this early stage. To better the accuracy we have integrated the One Click RICS WLCA +A2 Assessment tool where possible, and used our own measures using the design information made available to us.

Jacquet, Tankersley - RIBA Stage 2 Embodied Carbon Intensity

The embodied carbon totals and embodied carbon intensity results of the Concept Design are as follows:

Jacquet, Tankersley

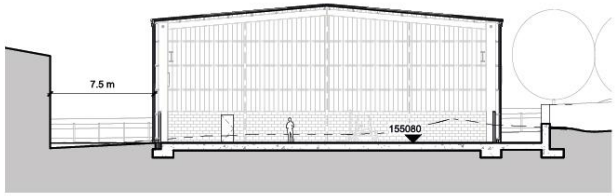




Jacquet, Tankersley

Proposed Site Plan and

Proposed Site Sections





Jacquet, Tankersley Stage 2 Planning Embodied Carbon Assessment Results					
GIA: 2,000m²	Emissions up to Practical Completion A1-A5 Result	Materials Linked Whole Life Carbon Emissions A1-C4	UK NZC Building Standard Mean Result	A1- A5 with 15% contingency	A1- C4 with 15% contingency
Embodied Carbon Intensity ($kgCO_2e/m^2$)	566	597	455	651	687
Total (tCO_2e)	1,132	1,194	910	1,302	1,374

Factors influencing these results are set out in section 2.0.

Client Objectives.

1. The client objective is to complete WLCA on the current design to respond to the Barnsley Local Pan and relevant SPD to satisfy the planning officers request for this study, and accompany the Energy & Sustainability Statement. To better the embedded sustainability of the development, the WLCA results will be acknowledged by the project team, and considered at future design stages.

Industry Definitions & Updates

Net Zero Carbon in Construction

When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, using offsets or the net export of on-site renewable energy.

Net Zero Carbon in Operation

When the annual carbon emissions resulting from operational energy consumption is offset via offset schemes or net export of renewable energy on-site. This would require annual emission quantification and offset payments.

Whole Life Net Zero Carbon

This includes the above NZC scopes but additionally looks to quantify and offset emissions associated with replacement of materials or refurbishment throughout the building's life cycle, and the end-of life impacts of deconstruction.

Industry Updates

Within the last year, a new *UK Net Zero Carbon Building Standard* has been drafted setting out new embodied carbon benchmarks for a greater variety of building types. Additionally, consultation on a 2nd edition to the RICS *'Whole life carbon assessment for the built environment'* has completed in September 2023 and is due to come into force in 2024. Furthermore, Mainer have been contributors to emerging UKGBC guidance, *Embodied Carbon of Construction*

Projects and Accounting for Scope 3 Emissions, which assesses where ownership of embodied emissions resulting from construction lie across a project team, and yearly inclusion of a developments' embodied emissions within annual scope 3 reporting.

The progress in industry guidance have been acknowledged when formulating this report. However, the methodology in the 1st edition of the RICS PS has remained applicable and for benchmarking purposes Mainer have used the existing and widely adopted LETI benchmarks.

Finally, in November 2023 UKGBC have released new guidance, *'Embodied Carbon: Improving your Modelling and Reporting'* as a guide for WLC Assessor's to better the consistency and quality of their work. It highlights the importance of accurate Assessor interpretation of project information, how to develop uncertainty factors and apply an overall certainty and confidence factor to the WLCA work and data. It also sets out how and why transparency must be provided in the modelling work behind the results stated. We have therefore sought to address these new recommendations throughout the report. We have outlined any assumptions made at Stage 2 along with any exclusions covered by allowances. All data selections made within One Click have been shared with the Client team, with supporting commentary detailing the information used to inform the data entry. Throughout we have presented a clear and descriptive account of the embodied carbon totals and how they have been arrived at. This is supported by transparency on the work and results to improve the credibility of the WLCA work.

Performance Against Industry Benchmark

The London Energy Transformation Initiative (LETI) set benchmark targets for embodied carbon performance in 2021, however this work did not include our building type. We have therefore detailed some new findings in the results summary from the UK NZC Building Standard on Industrial Warehouse and Logistical Buildings which is currently out to consultation on developing benchmarks for a variety of building types.

Current embodied carbon intensity results (with contingencies) for this scheme are 196 $kgCO_2e/m^2$ over mean results taken from as-built or Stage 6 WLCA completed on this building type. It is important to compare early concept result against Stage 6 WLCA result to understand the difference between concept detail and as-built detailed and accuracy of data.

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Assessment Methodology



1.0 ASSESSMENT METHODOLOGY

1.1 Methodology and Assessment Scope

As noted, the Stage 2 Whole Life Embodied Carbon assessment has followed the RICS Professional Statement: *Whole Life Carbon Assessment for the built environment* (referred to as the 'RICS PS' for the remainder of this document). The RICS PS aligns the work undertaken to BS EN 15978: 2011 (Sustainability of construction works – Assessment of environmental performance in buildings – Calculation method).

The RICS PS serves as a guide to the practical implementation of the BS EN 15978 principles. It sets out technical details and was used as the methodology for the assessment.

This section of the report sets out responses to the mandatory modelling and reporting requirements which WLCAs must adhere to and report on.

The assessment has covered the minimum scope set out in the supporting reporting templates, *Appendix C Building Element Categories and Appendix Concept reporting requirements and Report Template - Buildings*.

LCA Consultant: Dominic Wintie, Mainer Associates

Third Party Verifier: not verified. The design is not detailed enough to warrant the work receiving a third-party audit.

Assessment Date: This assessment is a Stage 2 WLCA and has been undertaken in December 2023 in response to planning officer comments. As per the Barnsley Local Plan, it is suggested the Client will revisit the WLCA at sequential RIBA Stage 4 and 5.

Purpose: The purpose of this assessment is to complete WLCA on the current design to respond to the Barnsley Local Pan and relevant SPD to satisfy the planning officers request for this study. As such a purpose of this work is to quantify the embodied carbon for both upfront and whole life emissions linked to materials, and support the Energy & Sustainability statement.

Building Description: The proposed development seeks to extend the current operations at the Jacquet facility to meet the expanding business which operates from the premises. The expansion is part of a major investment of the business into its UK operations, with the creation of 15 new employment

opportunities. The proposed development seeks to erect a 2,000sqm Storage and Manufacturing Warehouse (Class B2/B8) on land immediately to the south of the existing factory building.

The new building will provide additional storage and manufacturing facilities for the expanding business. The new building will provide additional secure storage for raw materials and machinery used in the manufacturing process.

Foundations: hardcore, concrete pad foundations, and reinforced concrete ground floor slab with insulation and vapour control membranes.

Frame: Structural Steel Frame including columns, beams, bracing and secondary steel beams.

Façade: Trapezoidal Profiled Metal Composite Panels, with supporting bracket system.

Roof: Trapezoidal Profiled Metal Composite Panels, Polycarbonate roof lights, aluminium eaves gutter.

Internal Walls: Blockwork walls as internal facing to external wall system. To our knowledge there are no stud partition walls proposed at this stage.

Floor, Wall and Ceiling Finishes: we anticipate a screed finish to the ground floor, a durable paint finish to the blockwork walls, and no ceiling finishes.

External Doors: Severe duty steel door sets, steel roller shutter doors.

Upper floors. To our knowledge there are no upper floors. The ground floor ceiling extends to roof, to accommodate trucks and cranes inside the building.

External Hard Landscaping: We understand there is s small area of tarmac hard standing being added to existing hardstanding car parks.

MEP: We understand the building is shell-only in a heating, cooling, and mechanical ventilation sense. A small offering of lighting, domestic water supply and point of use water heating would be provided.

Spatial Boundaries

The projects planning red line shown on JCL-1688-01-HW-001 P1 has been used as the fixed site boundary to ensure materials within this area, including contiguous land and external works delivered with the main build under the building contract have been accounted for. Use of a defined area is often referred to as the assets 'system-boundary', and aids determination of the spatial and temporal inputs and outputs, as well as the data collection required.

Note however, for LETI benchmarking purposes external areas, FF&E, PV have not been included in the results. Where third party verification of the work is sought, the auditor must be made aware of this.

Building Physical Characteristics

A complete WLCA should cover all items listed in the Project Bill of Quantities, cost plan, or as identified in other design information. As this assessment is for an outline planning application, the WLCA is based on Stage 2 Concept detail. Endeavours have been to ensure all materials shown on the drawings provided have been included and accounted for. Assumptions and allowances have been made where data on materials is not available, but would be present once the building is handed over.

Building Elements

Building elements (where applicable) detailed in the supplementary RICS reporting templates have been appropriately covered. This is also shown in Appendix B, which sets out materials allocated to each element and corresponding embodied carbon results.

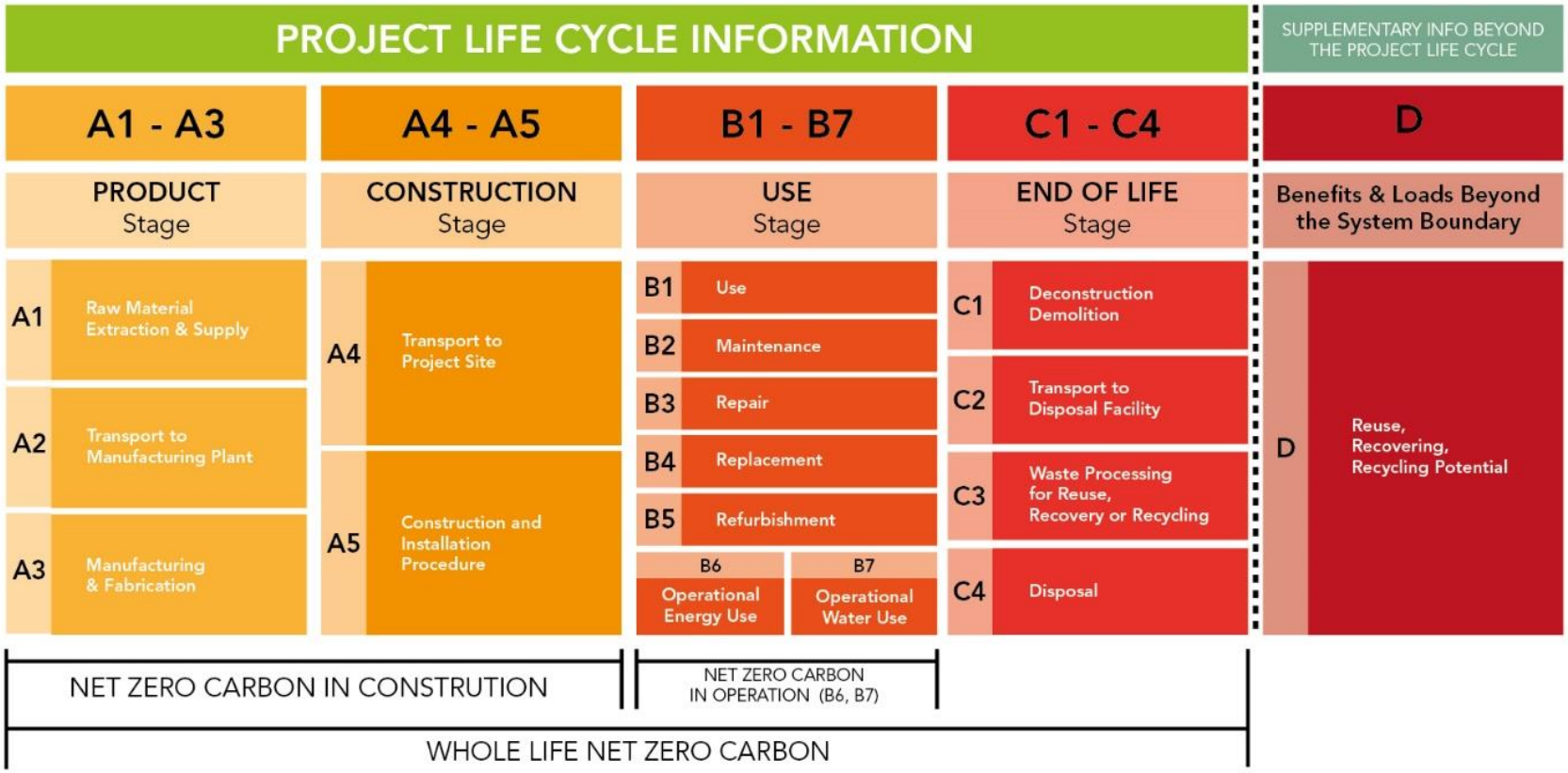
Although this WLCA is commensurate to Stage 2 design detail, it can be stated with confidence a minimum 95% of each building elements mass has been accounted for in the assessment. The RICS methodology calls for a minimum 95% of the cost allocated to each building element to determine the extent of materials accounted for in favour of using material mass. Mainer have however opted to use mass as a cost plan is not available.

1.2 Reference Study Period

The reference study period and building life cycle is 60years.

1.3 Building Life Cycle Stages

Embodied carbon emissions have been reported for building life cycle stages or 'modules', for: A1-A3, A4, A5, B1, B4, and C1-C4. B6 emissions operational energy and B7 operational water consumption have not been modelled at this stage as there is no information on the servicing strategy at this time.



This scope and focus on materials would be defined by the RICS PS (1st edition) as *'embodied carbon over the life cycle'*. Mainer also term this life cycle scope as *'materials-linked whole life carbon emissions'* and have used this reference in this report.

A1-A3 Material Extraction, Transport, & Product Manufacture

A1-A3 are influenced by the carbon factors quantified within an Environmental Product Declaration (EPD). This design information and primarily drawings have informed the EPD selection which determines the A1-A3 carbon emission factor applied to each material. A total emission factor for each material is generated when applying the EPDs carbon factor to the total rates of materials.

Mainer Associates acknowledge that the EPD selection and carbon emission factors have significant bearing on the final upfront A1-A5 results, and the developments performance against industry benchmark. We understand the importance of selecting suitable and representative embodied carbon factors (EPDs) to the given elemental material specifications and quantities.

Table 16 of RICS PS provides default specifications for main building materials, where designs are in concept stages and specification detail is not available. In several instances Maine have opted for worst-case options on cement replacement and steel scrap content, as where the default assumptions applied by RICS are deliverable with the supply chain we would underestimate these initial predictions on the final result.

We have set out our approach to EPD selection further on in this section and detailed confidence and quality testing the data for the top 10 materials which have greatest bearing on the A1-A3 emissions. Critically we have also provided transparency to the Client on the selections made (see Appendix B).

A4 Transport to Site

At this early-stage default transport distances have been used as supply chain data and production locations are not known. Use of default distances is the approach to take where information is not available. Defaults used are listed in Appendix A.

We assume the distance also account for return journeys which the RICS methodology requires. The defaults therefore align the A4 entry to the RICS methodology and covered the distance between the manufacturing location and the project site, whilst accommodating the estimate supply chain route of each item.

A5 Site Impact Emissions

Site impact data inclusive of temporary facilitating works, energy and water consumption, plant fuel consumption have been estimated at using the building GIA. This default applies 36 $kgCO_2e/m^2$ has been used instead of the projects' capital costs as a cost plan has not been produced at this stage. This will be rounded up to 40 $kgCO_2e/m^2$ in line with the RICS method.

Site Wastage factors have been predicted using RICS default values applies in the One Click.

Materials that do not form part of the asset such as formwork or hoardings and additional trips to site have not been included at this stage. Estimates on this data are not available.

B1 Use Phase

The extent of servicing and the heating and cooling requirements are not known at this stage, and it is assumed the warehouse space is a shell only fit out. No design detail on possible plant has been produced at this stage. No emission impacts from refrigerant leakage has therefore been calculated for the B1 module.

Carbon absorption of carbon emissions resulting from carbonation of concrete materials have been predicted by One Click LCA software.

B2 Maintenance

Emissions resulting from asset maintenance and from any activities relating to maintenance processes, including cleaning, as well as any relevant products used and waste produced over the buildings life cycle have been predicted using the building GIA. The default average maintenance profile applies 10 $kgCO_2e/m^2$. And influences the whole life emission result. This has been used in the absence of accurate energy, water, and waste data resulting from maintenance.

B3 Repair

B3 Emissions must take into account carbon impacts from all activities that relate to repair processes, and any products used and waste produced over the reference study period (RSP). For this assessment, the repair impacts have been assumed as equivalent to 25% of B2 maintenance impacts for the relevant

items and 10% of A1–A3 impacts for MEP. As MEP is not accurately mapped at this stage, B3 emissions will be quantified and included in results at future RIBA Stages

B4 Replacement

The results for these emissions have been informed by product life expectancies detailed in Environmental Product Declarations (EPDs) or default assumptions from One Click 9informed by RICS), which assume like-for-like replacement over the RSP. These assumptions applied by the software essentially multiply the original A1-A5 emission for each material, by the number of times it would be replaced in a typical 6oyr life cycle. We have therefore accounted for impacts from the production, transportation to site and installation of the replacement items.

B5 Refurbishment

Given the warehouse is considered shell only, the asset may not require a refurbishment throughout the 60yr RSP. However, it could be assumed that the external composite cladding would need to be replaced at least once in this time period, and the ground floor slab and internal blockwork walls may need to undergo refurbishment works. Where refurbishment occurs, the recommendation is to conduct a WLCA on the refurb itself during its design and construction phases. As such, no emission estimate has been applied to B5 at this stage.

B6 Operational Energy

Energy figures should including emissions arising heating, hot water, cooling, ventilation, lighting, cooking, equipment and lifts, broken down separately by fuel type and energy end use.

In the new 2nd edition of RICS, the methodology has changed from using BRUKL figures applying both current and decarbonised scenario, to instead requiring annual energy consumption in kWh or equivalent to be converted to carbon using the appropriate carbon conversion factor sets. The new methodology also suggests TM54, NABERS and prediction modelling should be used.

At Stage 2 no information has been provided on the building predicted energy consumption and therefore not been included at this stage.

Where Mainer reference ‘whole life embodied carbon emissions’ we therefore refer to materials-linked whole life embodied carbon emissions.

B7 Operational Water Consumption

The building will be shell only with a single WC with toilet and handwash. Occupancy numbers are not known at this time and due to this operational tap water and waste water have not been modelled.

C1 Deconstruction and Demolition

Emissions relating to end-of-life demolition have been estimated using the building area.

C2 EOL Transport Impacts

One Click LCA has software has estimated emissions arising from transportation of material from deconstruction and demolition.

C3 Waste processing for reuse, recycling or other recovery

We have assumed all materials would eventually be disposed on in the UK. For UK based EPDs we have allow the One Click software to assume the end-of-life scenario listed in the EPD. For EPDs representing products produced in countries outside of the UK, we have manually altered the EOL assumption in the one click materials log in line with Table 23 of the RICS 2nd Edition methodology and WRAP guidance to ensure EOL routes applicable to the UK are factored into the assessment.

C4 Disposal Impacts

As per commentary against C3.

1.4 Building Area Measurement

The unit of measure used is Gross Internal Area (GIA). The total GIA provided is 2,000 m^2.

1.5 Units of Measurement

The whole life carbon results have been reported using $kgCO_2e/m^2$ and tCO_2e.

1.6 Allowable Carbon Data Sources

The environmental product declarations and data sources used are aligned to the acceptable data sources and standards listed in Table 11 of the RICS 2nd edition PS. As per the methodology, where exact product specific EPDs do not exist, permissible carbon data for equivalent or very similar products is used. Geographical and technologically appropriate and representative data has been selected in these instances. EPDs and data produced within the last 5 years has been used unless manufacturer specific EPDs produced using primary manufacture site and product-specific data, that were produced over 5 years ago, were deemed more representative.

Further context on the EPD selection process is given in section 2.10. Section 3.0 also demonstrates the data and EPD selections have been tested for certainty and quality.

1.7 Assessment Scope

This study covers the following building components:

- Foundation arrangement
- Ground floor
- Roof
- Façade
- Superstructure – frame
- Internal blockwork wall
- Internal finishes (estimated)
- External Doors
- External works

Where information has not been provided or is unavailable, assumptions from the RICS guidance were adopted.

1.8 Estimates, Assumptions and Exclusions

Other than assumptions and default values used to apply emissions results to several of the life cycle stages set out in section 2.7, this section summarises here assumptions made when interpreting the design information and entering data into One Click

Estimates

- Numbers of and Lengths of structural steel columns, beams, and secondary beams.
- Areas of cladding and roof cladding.
- Areas for external doors.
- The small lighting and domestic water offering has been assumed using GIA rates.

Assumptions

- The trapezoidal metal panels are 150mm thick.
- The trapezoidal metal panels require a fixing/bracket system.
- Blockwork walls have 2 courses and each course is 140mm thick.
- Typical weight per for S355 structural steel has been applied.
- 0% scrap content to structural steel (worst-case scenario).
- 0% cement replacement to concrete mixes (worst case scenario).
- The ground floor concrete will receive a screed finish.
- The ground floor will feature an insulation.
- 70k/m^3 rebar rate.
- Contingencies have been detail to allow for MEP and additional detail at future stages.

Exclusions

- WC and sanitaryware

- Electric panel heaters.
- Point of use water heater
- MEP materials.

1.9 Data Sources

Stage 2 design information has been used to measure and estimate quantities of the materials shown on drawings. This interpretation and the quantities entered have been shared with the designers for comment. Mainer would amend quantities where comments are made and changes are necessary. At stage 2 material measures and cost plans have not been produced. Design information as therefore been used.

The following information has been used to enter quantity data into One Click LCA software and inform data selections:

- Inspire design and access statement JCL-1680-01-DAS-001
- Inspire supporting planning statement JCL-1688-01-PS-001
- Proposed roof plan SASA-DR-A-04100
- Proposed elevations SASA-DR-A-0521
- Proposed sections SASA-DR-A-06311
- Proposed site sections SASA-DR-A-06321
- Inspire HGV Tracking Plan CL-1688-01-HW-001 P1

The EPD selections made are based on the above datasets and design information, and therefore directly inform the carbon emission factor applied to each materials, and together with our quantities, inform the A1-A3 emission result.

1.10 Selecting EPD's

As noted above, Mainer have selected geographically and technically applicable EPDs. In the summary the process for entry of each material/specification has been:

1. Interpret the Stage 2 design information to ascertain materiality and products of each key component.
2. Using experience in working with supply chains, we have considered where these materials are typically produced.
3. We have then followed steps detailed Table 11 *Carbon data quality matrix* to:
   - select EPDs which a technologically representative of the materiality.
   - all products identified can be manufactured in the UK, we have thought sought to select geographically representative UK based EPDs.
   - ensure the EPD/carbon factor data was generated in the last 5 years.
   - the data has been independently verified to ISO 14025 as a minimum, and third party independently verified to EN 15804 where possible.
4. Due to the early stage of the design no inference on product specifications is detailed in the design information, which is expected at this stage. Mainer have therefore deliberately selected more regionally generic EPDs to represent products. For example, we have selected a generic carbon factor representing production and structural S355 steel across the UK which utilises regionalised datasets to apply a $kgCO_2e/kg$. it would be incorrect to select an EPD for a specific steel manufacturer as it is not known as this stage where and who the steel will be sourced. Selecting more product specific EPDs would therefore skew results.
5. Selections have been checked with the design team through provision on Appendix B.

Results



2.0 RESULTS AND ANALYSIS

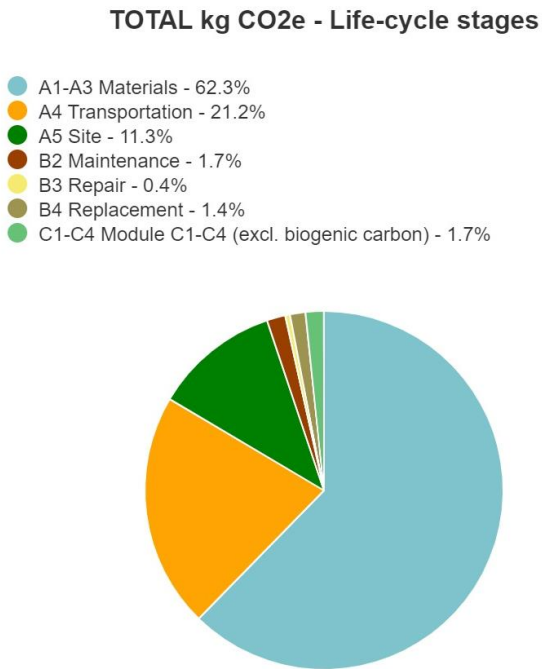
Results stated in this section are results based on the information provided to us which has informed the data entry.

When interpreting these results, the project team should consider a 15% contingency factor as a minimum due to the early outline planning stage and detail of material data at this stage. Consideration must also be given to the uncertainty factor calculated in section 2.6 which has been calculated to illustrate uncertainty when undertaking WLCAs at the early, although not added to any results.

2.1 Building Life Cycle Modules

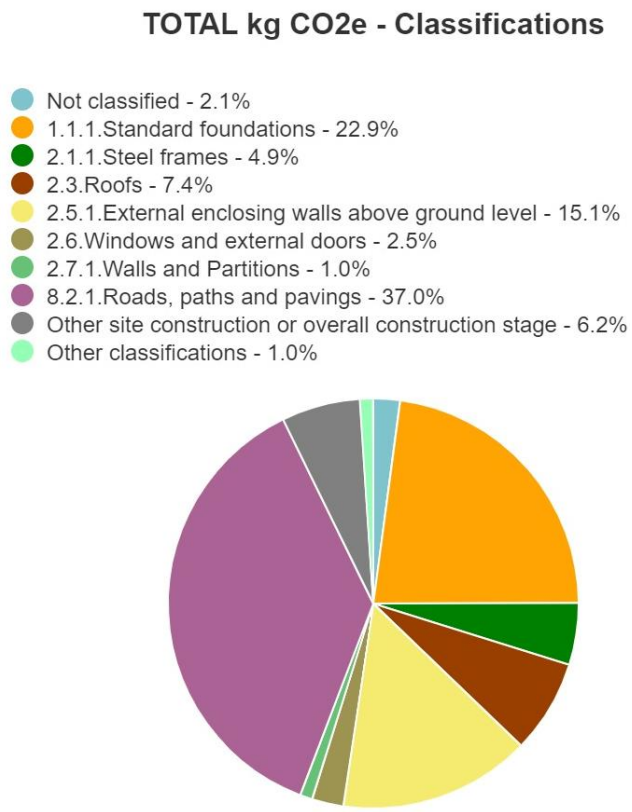
Table 3.0: Life Cycle Stage Results Stage

Life Cycle Stages	A1-A3	A4	A5	B4	C1-C4
Stage 2 Total tCO_2e	655.35	252.98	135.39	16.64	22.56
$kgCO_2e/m^2$	327.68	126.48	67.69	8.82	603.71



2.2 Building Elements

Table 5.0: Building Element Results A1-A3				
Building Element	**Excavation**	**Standard Foundations**	**Steel Frame**	**Paint finishes**
Stage 2 Results tCO_2e	5.57	249.24	55.73	0.23
$kgCO_2/m^2$	2.79	124.62	27.87	0.12
Building Element	**Flooring**	**Screed**	**Roofing**	**Cladding**
Stage 2 Results tCO_2e	1.18	1.34	83.29	155.75
$kgCO_2/m^2$	0.59	0.67	41.64	77.88
Building Element	**Ceiling Finishes**	**External Doors**	**Int. Doors**	**Int. walls**
Stage 2 Results tCO_2e	0.48	16.02	0.13	0.92
$kgCO_2/m^2$	0.24	8.01	0.06	0.46



Please note that tCO2e for Services is yet to be included. Of the total tCO_2e, a 15% additional factor will be applied, as this would typically equate to tCO2e for services.

2.3 Highest Impact Materials

This section details the highest contributing materials across A1-A3 emissions involved in raw material extraction and production of the products/materials. These have been tested for both quantity and carbon data certainty scores, to aid determination of an overall certainty factor for the WLCA.

Table 7.0: Most contributing materials total tCO_2e (A1-A3)

Product	Environmental Product Declaration	tCO_2e (A1-A3)	Carbon Data Confidence Score	Carbon Data Uncertainty Factor
Ready-mix concrete, normal strength, generic, C32/40 (4600/5800 PSI) with CEM I, 0% recycled binders (300 kg/m3; 18.7 lbs/ft3 total cement)	One Click Regional UK EPD 2022	299	37	1%
Sandwich panel with glass wool insulation and double steel siding, U=0.23W/(m2K), 181.1mm (Total), 0.7mm (Outer sheet), 0.4mm (Liner sheet), 180mm (Insulation), 13.37kg/m2, 73.8kg/m3	Tata Steel Europe & CA Building	149	37	1%
Epoxy resin, EU avg., 1-1.25 kg/l, filled and/or aqueous with low content of filler	FEICA	66	26	3%
Sandwich panel with glass wool insulation and double steel siding, U=0.35W/(m2K), 121.1mm (Total), 0.7mm (Outer sheet), 0.4mm (Liner sheet),	Tata Steel, Twin-Therm® wall and Twin-Therm® FW	66	38	1%

120mm (Insulation), 11.89kg/m2, 98.18kg/m3				
Reinforcement steel (rebar), generic, 60% recycled content, A615	One Click LCA Regional UK 2022	42	35	2%
Structural steel horizontal beams	One Click LCA International France 2022	35	29	3%
Reinforcement steel fine mesh, French average, 0.662 kg/m2	One Click LCA International France 2022	23	26	3%
Structural steel profiles, generic, 0% recycled content (only virgin materials), I, H, U, L, and T sections, S235, S275 and S355	One Click LCA Regional UK	19	33	2%
Aluminium roller shutter door, grid connected, 0.78 m x 1.178 m, 11.7 kg/m2	VELUX Group	14	28	3%
Crushed rock (0…100 mm), wet bulk density, 2000 kg/m3	One Click LCA National UK	6.5	29	3%

2.4 Uncertainty Factor

For WLCAs there are uncertainties particularly during the early design phase when far less is known about the final design and materials. This uncertainty is managed by developing a WLCA uncertainty factor, which is made up of three component parts:

- **Contingency factor** - based on the project phase, is applied at during all project phases to modules A, B, C and D. It reflects uncertainty regarding the design of the asset, its construction and the quantities and types of materials used. The scoring system can be seen in table 11.
- **Carbon data uncertainty factor** - based on the representativeness and quality of the carbon data used for materials. It is added during the detailed design, construction and post-completion phases. It reflects uncertainty regarding the representativeness of the carbon data in relation to the impact of the actual products that will be used, and the quality of the data. The scoring system can be seen in table 8 & 10.
- **Quantities uncertainty factor** - based on the expected accuracy of the material quantities data being used in the project. It is also added during the detailed design, construction and post-completion phases, and reflects uncertainty regarding the quantities of the products that will be used. The scoring system can be seen in table 12 & 13.

Table 8 is a carbon data quality matrix used to generate a data confidence score, this has influenced the WLCA Data confidence score that can be seen in table 7. Using table 9 the uncertainty score is calculated based on the calculated confidence score. Once this is obtained the quantities uncertainty factor is calculated based on tables 12 & 13. Once these scores percentages are identified they can be added together to produce the WLCA uncertainty factor.

The WLCA uncertainty factor percentage for the BIOS scheme at Stage 5 is broken down below and the scores achieved on BIOS can be seen in table 9:

Contingency - 15%

Uncertainty - 22%

Quant - 24%

Jacquet WLCA uncertainty factor percentage total = **61%**

This would equate to **636.67tCO$_2$e** of the A1-A5 result and **659.77tCO$_2$e** of materials-linked whole life emissions. The RICs methodology requests the total combined percentage is added to the results and reported separately when third party verification is sought. The calculation and results have been stated here for information purposes only and serve to illustrate why WLCAs should be done at each stage and particularly at Stage 4 and Stage 6. The results would be **1,680tCO$_2$e** (A1-A5) and **1,740.77tCO$_2$e** (A1-C4 materials) if taking this uncertainty into account.

Carbon data quality matrix used to generate data confidence scores during technical design, construction and post-completion phases; these are assessed for each key product/material and then averaged, weighted by their embodied impact												
	Geographical representativeness (maximum 10 points)		Technological representativeness (maximum 12 points)				Technological representativeness - assess either as an EPD or generic dataset (maximum 8 points)				Data aspects (maximum 10 points)	
	Geography		Technology		Product specificity		For EPD		For generic datasets		Granularity		Verification	
Very good	Refers to the specific geographic context for large countries, same region (e.g. UK for UK)	**10**	Reflects identical technology (e.g. BF/BOF steel with similar recycled content)	**6**	Data for actual product used	**10**	Year of data collection less than 4 years from year of construction	**8**	Reference year less than 3 years or published less than 2 years from year of construction	**8**	Site-specific data (actual factory and manufacturer used)	**5**	Third-party independently verified to EN 15804	**5**
Good	Refers to a similar geographic context (e.g. UK data for Ireland)	**7**	Partially reflects the technology and technical characteristics (e.g. BF/BOF steel with different recycled content)	**4**	Representative or average product adapted by relevant characteristic (e.g. data per m2 adapted by mass/ m2 or scaling factor provided	**5**	Year of data collection less than 7 years from year of construction	**6**	Reference year less than 6 years or published less than 5 years from year of construction	**6**	Manufacturer specific data (actual manufacturer used and average site or different site)	**4**	Independently verified to ISO 14025	**4**
Fair	Refers to a very different geographic context or much larger region (e.g. Italy for UK, EU for UK)	**4**	Does not satisfactorily reflect the technology and technical characteristics (e.g. steel generally)	**3**	Average data/ representative product for product group of actual product used	**4**	Year of data collection less than 10 years from year of construction	**4**	Reference year less than 10 years or published less than 10 years from year of construction	**4**	Regional sector data (e.g. UK or EU)	**3**	Peer reviewed to ISO 14044	**3**
Poor	Refers to a totally different context (different continent, e.g. Canada for UK, EU for China)	**2**	Does not reflect the technology and technical characteristics at all (e.g. EAF steel for BOF steel)	**1**	Any proxy dataset or data extrapolated from group of datasets	**2**	Year of data collection less than 15 years or published more than 10 years from year of construction	**2**	Reference year less than 15 years or published more than 10 years from year of construction	**2**	Global sector data	**2**	Not verified or peer reviewed	**0**
Very Poor	No evaluation made	**0**	No evaluation made	**0**	No evaluation made	**0**	Other or no evaluation made	**0**	No evaluation made	**0**	Proxy data or no evaluation made	**0**	No evaluation made	**0**

Table 8: Carbon data quality matrix.

Carbon Data Uncertainty Factor									
	Geographical representativeness (maximum 10 points)	Technological representativeness (maximum 12 points)		Technological representativeness - assess either as an EPD or generic dataset (maximum 8 points)		Data aspects (maximum 10 points)		Carbon Data Confidence Score	Carbon Data Uncertainty Factor
Product	Geography	Technology	Product specificity	For EPD	For generic datasets	Granularity	Verification	Total	
Ready-mix concrete, normal strength, generic, C32/40), 0% recycled binders)	10	6	5		8	3	5	**37**	**1%**
Sandwich panel with glass wool insulation and double steel siding, U=0.23W/(m2K), 13.37kg/m2, 73.8kg/m3	10	6	6	6		4	5	**37**	**1%**
Epoxy resin, EU avg., 1-1.25 kg/l, filled and/or aqueous with low content of filler	4	6	4		4	3	5	**26**	**3%**
Sandwich panel with glass wool insulation and double steel siding, U=0.35W/(m2K), 121.1mm (Total), 0.7mm (Outer sheet), 0.4mm (Liner sheet), 120mm (Insulation), 11.89kg/m2, 98.18kg/m3	10	6	5	8		4	5	**38**	**1%**
Reinforcement steel (rebar), generic, 60%	10	4	5		8	3	5		**2%**

recycled content, A615									
Structural steel horizontal beams	4	4	5		8	3	5		**3%**
Reinforcement steel fine mesh, French average, 0.662 kg/m2	4	4	5		6	3	4		**3%**
Structural steel profiles, generic, 0% recycled content, I, H, U, L, and T sections, S235, S275 and S355	10	4	5		6	3	5		**2%**
Aluminium roller shutter door, grid connected, 0.78 m x 1.178 m, 11.7 kg/m2	4	4	5		8	3	4		**3%**
Crushed rock (0…100 mm), wet bulk density, 2000 kg/m3	10	4	5		4	3	3		**3%**

Table 9: BIOS Carbon data quality matrix score for BIOS

Asset Carbon Confidence Score	≤10	10<15	15<20	20<25	25<30	30<35	35<40	40
Carbon Data Uncertainty Factor	7%	6%	5%	4%	3%	2%	1%	0%

Table 10: Carbon data uncertainty factor.

Project Phase	Default contingency factor to apply to all life cycle stages and modules
Early Design	15%
Technical Design and Construction	6%
Post-completion	0%

Table 11: Life cycle stage contingency factor.

Quantities Uncertainty Levels (QULs)	QUL Score	Examples
Very Good	0	Actual measured / delivered quantities
Good	1	Design measured / calculated / modelled averages
Fair	3	Estimated building information
Sufficient	5	Benchmark building information

Table 12: Quantities uncertainty levels.

Asset QUL Score	<0.5	<1	<2	<3	3-5
Quantities Uncertainty Factor	0%	1%	2%	3%	4%

Table 13: Quantities uncertainty factor.

Product	Asset QUL Score	Quantities Uncertainty Factor
Ready-mix concrete, normal strength, generic, C32/40), 0% recycled binders)	3	3%
Sandwich panel with glass wool insulation and double steel siding, U=0.23W/(m2K), 13.37kg/m2, 73.8kg/m3	1	1%
Epoxy resin, EU avg., 1-1.25 kg/l, filled and/or aqueous with low content of filler	3	3%
Sandwich panel with glass wool insulation and double steel siding, U=0.35W/(m2K), 121.1mm (Total), 0.7mm (Outer sheet), 0.4mm (Liner sheet), 120mm (Insulation), 11.89kg/m2, 98.18kg/m3	1	1%
Reinforcement steel (rebar), generic, 60% recycled content, A615	3	3%

Structural steel horizontal beams	3	3%
Reinforcement steel fine mesh, French average, 0.662 kg/m2	3	3%
Structural steel profiles, generic, 0% recycled content, H, U, L, and T sections, S235, S275 and S355	3	3%
Aluminium roller shutter door, grid connected, 0.78 m x 1.178 m, 11.7 kg/m2	1	1%
Crushed rock (0…100 mm), wet bulk density, 2000 kg/m3	3	3%

Improvements to the Analysis

3.0 IMPROVEMENTS TO THE ANALYSIS

WLCA as a Sequential Process

This WLCA has been completed at Stage 2 for an outline planning application. As such, the detail and accuracy of the assessment is commensurate to the detail designed at this time. As per the RICS methodology recommendation, Mainer suggest the WLCA is revisited at each RIBA Stage and particularly Stage 4 and Stage 5. Through the RIBA stages, we can gradually reduce the amount of contingencies and assumptions applied in the analysis at this stage. Doing so will allow a more accurate result of the *actual* embodied carbon to be predicted and estimated.

We recommend that the WLCA is revisited at Stage 4 once the design is complete and at Stage 6 as a minimum.

EPD Selections

EPD selections have been made based on information provided. As discussed, the detail at this stage is outline detail only. Generic EPDs have therefore been selected which ultimately determine the A1-A3 result, which typically has significant bearing on the result. Again, as product specifications become more refined in future stages, the data selections should be updated.

Data Accuracy

Drawings and a cost plan of materials have been provided at this time due to the early stage of the project. Quantities have therefore been based on the WLCA Assessor's (Mainer) interpretation of the drawings. Whilst experience in interpreting design drawings, the accuracy of the quants would be improved where measures are confirmed by each design discipline, at future RIBA stages. We recommend this is done also with a view to exploring possible reductions. Once the results are confirmed to better accuracy we can be better informed to assess potential specifications and local sourcing that could serve to reduce the embodied carbon results.

WLCA Certainty Factor

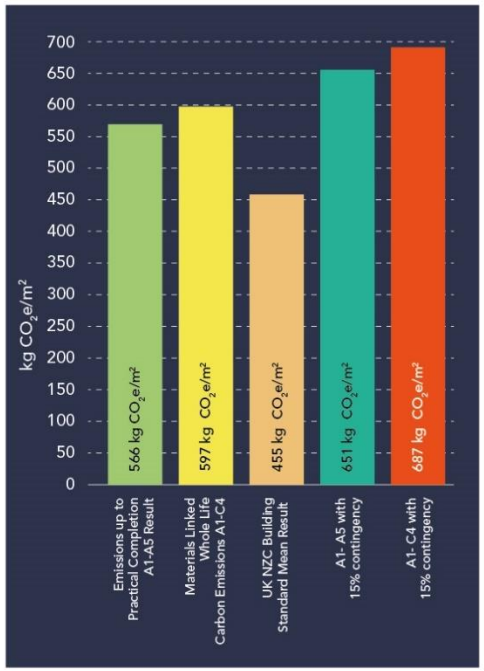
Mainer associates have calculated the (un) certainty factor for the 10 materials contributing most significantly to the A1-A3 emission results. This is as per the 2nd edition of the RICS methodology. To improve the analysis further, we could expand this to the top 25-50. Review could also be undertaken with Wates to consider the geographical, technological and temporal representativeness and the data aspects of the top 50 selections.



Conclusion

4.0 CONCLUSION

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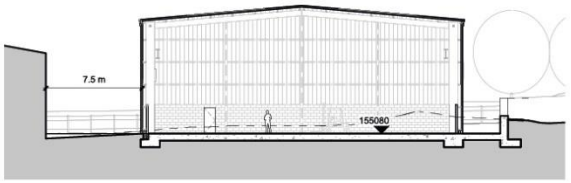


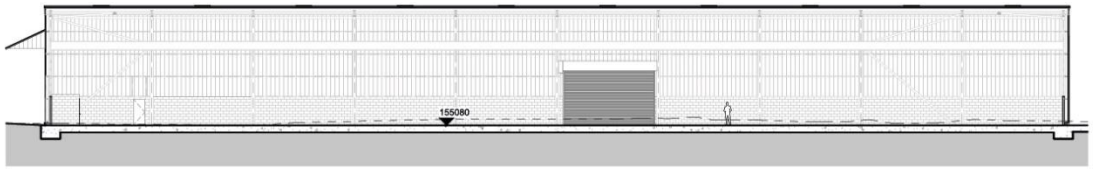


Jacquet, Tankersley

Proposed Site Plan and

Proposed Site Sections





Jacquet, Tankersley Stage 2 Planning Embodied Carbon Assessment Results					
GIA: 2,000m²	Emissions up to Practical Completion A1-A5 Result	Materials Linked Whole Life Carbon Emissions A1-C4	UK NZC Building Standard Mean Result	A1- A5 with 15% contingency	A1- C4 with 15% contingency
Embodied Carbon Intensity ($kgCO_2e/m^2$)	566	597	455	651	687
Total (tCO_2e)	1,132	1,194	910	1,302	1,374

Appendices

APPENDIX A: RICS DEFAULT ASSUMPTIONS

Table 2.0: Material Specification Assumption for 'Baseline Building' as per RICS Professional Statement			
1	Concrete	Piling	C32/40 20% cement replacement [1]
		Substructure	C32/40 20% cement replacement [1]
		Superstructure	C32/40 20% cement replacement [1]
		Generic concrete	C16/20 0% cement replacement [1]
2	Steel	Reinforcement bars	97% Recycled content [2]
		Structural steel sections	20% Recycled content [3]
		Studwork/Support frames	Galvanised steel, 15% Recycled content [4]
3	Blockwork	Precast concrete blocks	Lightweight blocks for building envelope
			Dense blocks for other users
4	Timber	Manufactured structural timber CLT, Glulam, etc.	100% FSC/PEFC [5]
		Formwork	Plywood
		Studwork/Framing/Flooring	Softwood
5	Aluminium	Cladding panels	Aluminium sheet, 35% Recycled content [6]
		Glazing frames	Aluminium extrusions 35% Recycled content [6]
6	Plasterboard	Partitioning/Ceilings	Min. 60% Recycled content [7]
7	Insulation	To floors, roofs, and external walls	PIR

Table 3.0: Material Transport Assumption for 'Baseline Building' as per RICS Professional Statement		
Transport Scenario	**km by road**	**km by sea**
Locally manufactured e.g. concrete, aggregate, earth	50 [1]	-
Nationally manufactured e.g. plasterboard, blockwork, insulation	300 [1]	-
European manufactured e.g. CLT, façade modules, carpet	1,500 [2]	-

Globally manufactured e.g. specialist stone cladding	300 [3]	10,000 [3]

Table 4.0: Material Life Span Assumption for 'Baseline Building' as per RICS Professional Statement

Building Part	Building Element/Components	Expected Lifespan
Roof	Roof coverings	30 years
Superstructure	Internal partitioning and dry lining	30 years
Finishes	Wall finishes Render/Paint	30/10 years respectively
	Floor finishes Raised Access Floor (RAF)/Finish layers	30/10 years respectively
	Ceiling finishes Substrate/Paint	20/10 years respectively
Façade	Opaque modular cladding e.g. rain screens, timber panels	30 years
	Glazed cladding/Curtain walling	35 years
	Windows and external doors	30 years

APPENDIX B: ONE CLICK LCA EXPORT